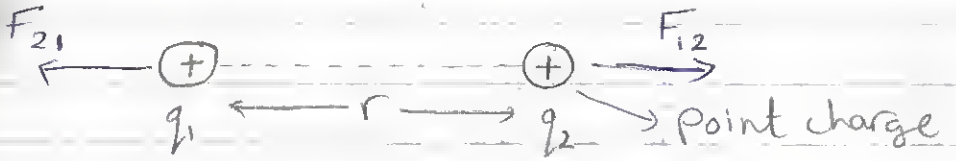
28-2-2013

# Electricity

## Coulomb's law




$F_{12}$ ⇒ Force by charge 1 on 2
$F_{21}$ ⇒ Force by charge 2 on 1

$|F_{12}| = |F_{21}| = F$ $\qquad F \propto \frac{|q_1||q_2|}{r^2}$

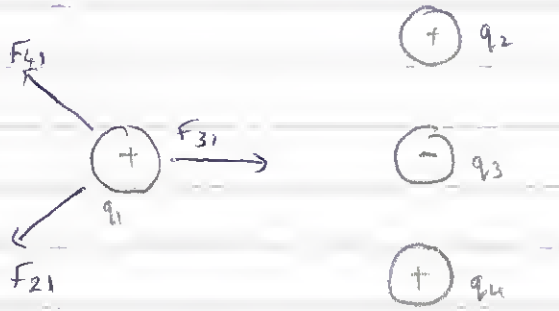
$$\boxed{F = \frac{k|q_1||q_2|}{r^2}}$$

$k = 9 \times 10^9$ in vaccum

$k = \frac{1}{4\pi\epsilon_0}$ $\quad \epsilon_0 = \frac{1}{4\pi k} = 8.85 \times 10^{-12}$

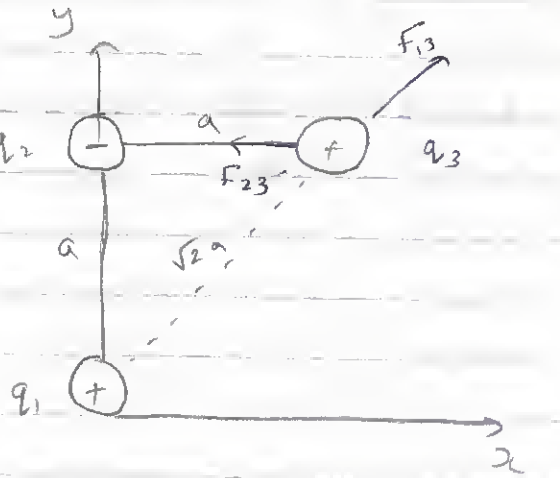
$\epsilon_0$ ⇒ permittivity of vaccum

* For n point charges:




Net force on $q_1$ $(F_1) = \vec{F}_{21} + \vec{F}_{31} + \vec{F}_{41}$

Find resultant force on $q_3$




$q_1 = q_3 = 5\,\mu C$ , $q_2 = -2\,\mu C$

$a = 0.1\,m$

$$|F_{23}| = k\frac{|q_2||q_3|}{r_{23}^2} = \frac{9\times10^9 \times (2\times10^{-6})\times(5\times10^{-6})}{0.1^2}$$

$$= 9\,N$$

$$\bar{F}_{23} = -9\hat{i}\ N$$

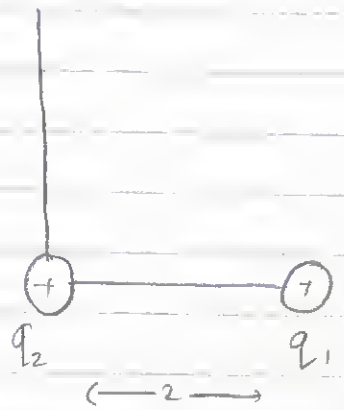
$$|F_{13}| = \frac{k|q_1||q_3|}{r_{13}^2} = \frac{9\times10^9\times(5\times10^{-6})^2}{(0.1\sqrt{2})^2} = 11\,N$$

$$\bar{F}_{13} = 11(\cos\theta\,\hat{i} + \sin\theta\,\hat{j})\ N \qquad \theta = 45^\circ$$

$$\bar{F}_{13} = 7.9\hat{i} + 7.9\hat{j}\ N$$

$$\bar{F}_3 = \bar{F}_{13} + \bar{F}_{23} = 7.9\hat{i} + 7.9\hat{j} - 9\hat{i} = -1.1\hat{i} + 7.9\hat{j}\ N$$

(Q) Find the position of $q_3$ such that $F_3 = 0$




$$F_{13} = \frac{kq_1q_3}{r^2} = \frac{9\times10^9\times15\times10^{-6}\times q_3}{(2-x)^2}$$

$$F_{23} = \frac{kq_2q_3}{r^2} = \frac{9\times10^9\times6\times10^{-6}\times q_3}{x^2}$$

$$F_{13} = F_{23}\ ,\quad \frac{9\times10^9\times15\times10^{-6}\times q_3}{(2-x)^2} = \frac{9\times10^9\times6\times10^{-6}\times q_3}{x^2}$$

$$\frac{15\times10^{-6}}{(2-x)^2} = \frac{6\times10^{-6}}{x^2} \qquad \frac{6}{15} = \frac{x^2}{(2-x)^2}$$

$$\sqrt{\frac{6}{15}} = \frac{x}{2-x} \qquad x = 0.775\,m$$

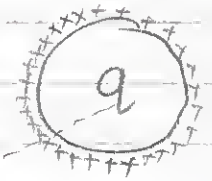
$q_1 = 15\,\mu C$

$q_2 = 6\,\mu C$

# Electric fields

Electric field intensity $\vec{E} = \frac{\vec{F}}{q}$

unit : N/C




1MC

test charge
(always +ve)